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STATE OF MAINE
PUBLIC UTILITIES COMMISSION

Docket No. 99-132

June 9, 1999

MAINE PUBLIC UTILITIES COMMISSION
Investigation Into Bell Atlantic-Maine's
Network Congestion Relief Practices

EXAMINERS' REPORT

NOTE: This Report contains the recommendation of the Commission's Advisory Staff. Although it is in the form of a draft of a Commission Order, it does not constitute Commission action. Bell Atlantic and the Public Advocate may file responses or exceptions to this Report on or before June 23, 1999.

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I. SUMMARY

We find New England Telephone and Telegraph Company d/b/a Bell Atlantic-Maine's (Bell Atlantic, Bell, or Company) network congestion relief practices to be inadequate. In certain circumstances, Bell's response to service quality deterioration due to network congestion falls short of its obligation to provide safe and reliable service. We direct Bell Atlantic to file a report within 60 days of the date of this Order explaining how the Company will address the problems described in the Order and prevent avoidable network congestion, such as that caused by Internet traffic, and how it will respond with more appropriate speed and effectiveness should similar problems arise in the future.

II. BACKGROUND

As early as 1996, Bell Atlantic's network was being affected by rapid growth of Internet traffic, in Maine and elsewhere. One measurable effect was its impact on "dial tone speed." Dial Tone Speed (DTS) is one of the performance criteria contained in the Service Quality Index (SQI) implemented in Docket No. 94-123 by the Commission as part of the Alternative Form of Regulation for Bell Atlantic. DTS is a measure of how quickly customers are able to obtain a dial tone from their local Central Office switch. On June 24, 1997, Bell Atlantic filed a request for a waiver of the DTS benchmark in its SQI, because the Company claimed that increased Internet usage had caused actual DTS performance to deteriorate, so much so that for the 1996/97 SQI year, actual DTS was twice the benchmark. Bell did not forecast - and claimed no one could have forecast - the growth in Internet traffic and the impact that would have on its network. Bell also claimed that to manage the network to the DTS benchmark would require a substantial increase in investment in Maine.

The DTS docket was eventually resolved through a stipulation which gave Bell significant relief from the previous benchmark and which dismissed half of the penalty amount that was due for their failure to meet the benchmark in the prior year. *New England Telephone & Telegraph Co. d/b/a Bell Atlantic, Request for Waiver of Dial Tone Speed*, Docket No. 97-389, Order Approving Stipulation (June 24, 1998) (Dial Tone Speed Order). In addition, the stipulation specified that the remaining half of the penalty was to be used to promote the use of trunk-side central office switch connections by Internet Service Providers (ISPs).[1] Bell Atlantic asserted that moving ISPs to the trunk side would relieve congestion in switches. The Company agreed to

[1]Attachment 1 describes the major parts of Bell's network in Maine.

develop a plan to encourage ISPs to migrate away from their more congested line-side switch connections. Bell eventually did file such a plan, which was approved by the Commission, that made it more economically viable for ISPs to move their traffic from the line sides of the switch.

In addition to the effect on dial tone speed delay caused by increased Internet usage, in 1996 Bell Atlantic had already noted other indications that more and more customers were relying on the Internet for various aspects of daily life. For instance, both the Company's New York and New England territories exhibited extraordinary growth in access lines, call holding times, and blocked calls. In addition, the number of ISPs in Maine was growing rapidly.

On March 9, 1999, the Commission opened this investigation into how Bell Atlantic is planning for, monitoring and relieving traffic congestion on its network, particularly through its central offices. The Commission also sought to examine how Bell Atlantic has responded to customers' complaints about lack of dial tone, slow dial tone speed, excessive busy signals, calls dropped while in progress and ringing with no party on the line. The investigation was to include Bell's communication with ISPs and interexchange carriers in responding to customers' complaints. As further described below in Section VI, the investigation was triggered by numerous complaints received by the Commission's Consumer Assistance Division (CAD).[2] *Maine Public Utilities Commission, Investigation Into Bell Atlantic-Maine's Network Congestion Relief Practices*, Docket No. 99-132, Order Opening Investigation (March 9, 1999).

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[2]The complaints were made by customers in communities served by "remote" switches. The Commission has received no congestion-related complaints from customers served by Bell's large "host" switches, and has no evidence that any host switch has become congested by Internet traffic.

As part of the investigation, the Commission's Advisory Staff issued a series of data requests to gather more information. On March 24, 1999, the Hearing Examiner directed Bell Atlantic to file daily reports to the Assistant Director of CAD on the status of correcting the continuing service problems reported by eight individual customers. On April 1, 1999, the Commission held a Technical Conference to allow the Advisory Staff and the Public Advocate to ask follow-up questions to the data requests. On April 15, 1999, Advisory Staff visited Bell Atlantic's Network Operations Center (NOC) in Manchester, NH. Personnel from BA's NOC and Network Administration Center (also in Manchester) provided information to the staff about the functions of their departments. On May 5, 1999, Advisory Staff members met with Bell Atlantic's Director of Operations for Maine, New Hampshire and Vermont who provided information on the Company's Quality Analyzer and Repair Center functions.

On April 27, 1999, the Commission issued an order directing the Advisory Staff to prepare an Examiner's Report recommending specific steps for Bell Atlantic to address the problems that network congestion has caused customers, the most serious being inability to obtain dial tone.

The Order stated that the initial investigation found:

1. Ineffective internal communication about network congestion problems among Bell Atlantic's network monitoring operations, its repair service centers, and its marketing operation;

2. Inadequate switch management practices, and congestion relief practices that either fail to fully relieve congestion or take too long to complete; and

3. The lack of a comprehensive long-term plan for predicting, addressing and ultimately preventing long-term capacity shortages that cause network congestion.

Docket No. 99-132 Order (April 27, 1999).

On June 9, 1999, the Advisory Staff issued a report containing its findings in these three areas and suggested approaches for addressing these problems.

III. NETWORK CONGESTION AND ITS IMPACTS

Congestion occurs in a telephone network when calling demand exceeds the network's call handling capacity. The congestion choke point in the network is the local exchange switch, which routes calls to their destinations. When a switch is congested, some calls do not go through, and are blocked. Calls can be blocked if the lines connecting the switch to another switch in the network are all in use. But according to Bell Atlantic, the major points of congestion are the "Line Concentration Units" - components that connect customer lines directly to the switch. The line unit is a "shared resource": the lines connected to it share a limited number of paths into the switch. If there are 640 lines connected to the line unit and they share 64 paths into the switch, then when 64 lines in that line unit are in use, all other call attempts made over any of the other 576 lines will be blocked; and according to Bell, those callers will hear a fast busy signal as soon as they dial, which indicates a congested switch. No call will go through that line unit until one or more callers using the paths into the switch hang up.[3]

Besides the fast busy signals (blocked calls), other symptoms of switch congestion are: no dial tone; slow dial tone; ringing with no one on the line; and disconnected or lost calls.[4] Although all these events reflect inadequate service, which

[3]**Advisors' Note: A January 1997 study ("The Effect of Internet Use on the Nation's Telephone Network by Economics and Technology, Inc.") stated that if all paths from a line unit into a switch are in use, then, until a path becomes free, all customers served by that line unit will get *no dial tone*, not a fast busy signal. In its response to this Report, Bell should comment on this point, and explain what specific *congestion* conditions cause Bell's Lucent and Nortel switches to fail to provide dial tone, to provide slow or delayed dial tone, and to block calls.**

[4]The last two named events may or may not be symptoms of switch congestion. They have been reported, however, in customer complaints that have included complaints of blocked calls (fast busy signals), no dial tone, and slow dial tone.

is a concern to us, we are most concerned with blocked calls and with no dial tone and slow dial tone events, which can reflect *unsafe* service, wherein callers may get no dial tone or a fast busy signal when they need to make emergency calls.

Bell Atlantic has contended the rapid growth in Internet traffic is the principal cause of switch congestion. Bell has stated that the call handling capacity of its local exchange switches has traditionally been sized to handle voice calls averaging 4 to 5 minutes. (The telephone term for the length of a call is "call holding time.") Internet calls are typically much longer -- averaging 45 minutes, according to Bell, or 10 times the switch's *designed* call holding time -- so that heavy Internet traffic, particularly during a switch's peak period, can overload the switch's call handling capacity and cause it to become congested.

The impact of the Internet on switch congestion is most severe when both Internet users and their Internet Service Providers (ISPs) are served by the same switch over common voice lines. Internet users' calls may have extremely long holding times, but after they end, the paths into the switch they were using are freed up for other callers. During peak periods, the ISPs' lines are almost always in use, and therefore the paths into the switch they are using are almost never freed up. As a result, during peak periods or when Internet use is high, customers whose lines are assigned to a line unit that has ISP lines in it will be the most likely to have their call attempts blocked.

[Advisors' Note: In its response to this Report, Bell should clarify exactly which events (among those both listed and not listed above) reflect network congestion. Bell should also identify which network performance reports contain these events by exchange, and the thresholds Bell has established for them.]

As for the impact of Internet *users* on switch congestion, many customers have obtained an extra telephone line strictly for accessing the Internet. If those Internet users stay connected for hours at a time, or worse, if they stay connected all day long, their lines probably cause more network congestion than ISPs' lines.

IV. BELL ATLANTIC'S CONGESTION RELIEF PRACTICES

Once a switch becomes congested Bell Atlantic uses a number of methods to attempt to relieve the congestion; each method is described below.

A. Load Balancing

If Bell determines a line unit is blocking a high percentage of calls, "load balancing" is a process of moving high use lines from that line unit to other line units that are experiencing less blocking. According to Bell, it can take up to **[Begin Proprietary] [End Proprietary]** to determine whether trunks or line units are causing congestion, and, if it is line units, which lines are causing it, and which line units they should be re-assigned to.

B. Converting Analog Lines to Digital Lines

The "concentration ratio" of a line unit is the ratio of the number of lines in the line unit to the number of paths into a switch. According to Bell, because there are far fewer digital lines than analog lines going into the switch, digital line units have lower *effective* concentration ratios than analog line units. Therefore, converting analog lines to digital can help relieve congestion caused by analog line units with high blocking rates.

This method of congestion relief appears to be quite limited. If digital facilities are available in an exchange's outside plant and at the switch, Bell can implement this method directly to relieve congestion on analog line units. It appears, however, that converting analog (copper) lines to digital (fiber) lines is normally driven not so much by the need to relieve congested line units as by other operational concerns, such as the need to replace deteriorating copper cable or the decision to

provision facilities to a new housing or commercial development on digital lines. In such instances, any resulting congestion relief would therefore be a by-product of addressing other operational concerns.[5]

C. Moving ISPs to the Trunk Side of Switches

Two types of lines are connected to a local exchange switch: lines from homes and businesses, and lines (called "trunks") from other switches, which are typically high capacity lines. The impact of Internet traffic on a switch is much greater if an ISP's connections to the switch are over access lines rather than higher capacity - and *non-blocking* - lines on the trunk side of the switch. The reason is that when Internet use is high, ISP access lines are almost always in use, each receiving one Internet call after another, thus tying up the limited paths into the switch, causing the line units to which the ISP's lines are assigned to block calls. According to Bell, moving an ISP from the line side to the trunk side of a switch relieves a major source of call blockage from the switch's line units.

This method of congestion relief, although it can immediately and dramatically improve in a congested switch's performance, is limited by the ISP's willingness and ability to invest in digital routers (to replace analog modems), which can cost upwards of $30,000 each, and to absorb the higher monthly rates of the digital trunk side connections to the switch. It can take months for an ISP to decide whether to make these investments.

D. Capacity Upgrades

[5]**Advisors' Note: If this interpretation is incorrect, Bell should correct it in its comments on this report.**

If a combination of the above methods does not relieve the congestion in a switch, Bell can add one or more line units to increase the switch's call handling capacity. A single additional line unit costs about $70,000, and delivery and installation can take up to 6 months from the day it is ordered.

E. Remove High Use Lines from the Switch

If Bell determines the impact on a switch of certain high use access lines threatens to cause unsafe service, Bell's tariff allows it to disconnect those lines from the switch.[6] This is a severe measure, which, according to Bell, has been implemented only rarely.

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[6]Bell's tariff states:

> The Telephone Company reserves the right to discontinue or refuse service . . . [if] [t]he use of the service [is] in such a manner as to interfere unreasonably with the use of the service by one or more other customers.

Part A, Section 1.3, Use of Service, Tariffs PUC-ME-No. 15, New England Telephone and Telegraph Company d/b/a NYNEX.

V. BELL ATLANTIC'S SWITCH MANAGEMENT AND MONITORING OPERATIONS AND REPAIR CENTERS

A. Network Operation and Administration Centers

Bell Atlantic monitors all 399 of its switches in Maine, New Hampshire, Vermont and Rhode Island at its Network Operations Center (NOC) and Network Administration Center (NAC), which are co-located in Manchester, NH. The switches are monitored in "real time," 24 hours a day, 7 days a week by 5 to 6 persons in each center, using a computerized system that checks hundreds of switch, switch peripheral, and trunk and line termination unit performance measurements.

The NOC staff detect and initiate repairs of malfunctioning or failed equipment. The NAC staff detect equipment that is functioning, but not functioning within established performance thresholds. It is the latter condition that constitutes the major cause of network congestion. Thus, it is the NAC that detects and confirms switch congestion, and evaluates which line units, and which lines assigned to each line unit, are causing the congestion. The NAC also directs load balancing efforts, and, if load balancing does *not* relieve the congestion in a switch, it recommends capacity upgrades to Bell's Switch Planning and Capacity Management Department, which is responsible for timing and sizing the capacity of switches and umbilical trunks and of capacity upgrades.[7]

The NOC and the NAC use the same switch monitoring system and data base (called "TDMS," for Traffic Data Management System). When a switch performs outside established thresholds, the TDMS generates "exceptions reports," which the

[7] "Umbilicals" are trunks that connect the smaller "remote" switches to the much larger and more powerful "host" switches.

NAC uses to determine if a switch is congested or becoming congested.[8] NAC's performance thresholds appear to be set as warning levels, not to reflect inadequate or unsafe service levels. Thus, presumably, some switching performance measurements can be outside established thresholds and yet the switch may still function properly.

[Begin Proprietary]

[End Proprietary]

B. Repair Centers

To respond to its customers in Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island who call to report service problems, Bell operates a "Centralized Service Bureau" in Andover, Massachusetts, with an overload center in Tewskbury, Massachusetts, staffed by approximately **[Begin Proprietary] [End Proprietary]** customer service personnel. According to Bell, the customer service intake personnel normally test the customer's line whenever a trouble call is received, regardless of the nature of the complaint. Intake personnel do not try to diagnose the problem or provide any information to callers about problems related to network congestion, even if the call comes from an area where Bell knows network congestion exists. The dialog and procedures used by customer service intake personnel seem to

[8] **[Begin Proprietary]**

[End Proprietary]

be unchanged from the pre-Internet time period, when problems caused by network congestion were rare; thus the procedures seem to concentrate only on access line and inside wire related problems, and not on problems caused by congestion in switch and network facilities. Customers may be told that troubles are "cleared" in instances where the problem is network- or switching-related, and yet nothing has been done to relieve the root cause of the trouble. Bell Atlantic states the repair center intake personnel pass network-related troubles on the Network Operations Department in Manchester, New Hampshire.[9] However, Bell has yet to respond to a Staff data request on how Network Operations personnel follow-up with customers on their trouble reports.

[9]**Advisors' Note: In its comments on this Report, Bell should explain what the Network Operations Department in Manchester does (including how many Bell Atlantic states it is responsible for) vs. what the Network Operation Center does, and how they relate to one another and interact, particularly on detecting and relieving network congestion.**

VI. CUSTOMERS' COMPLAINTS AND BELL ATLANTIC'S RESPONSES

A. Customer Complaints

On December 16, 1998, the owner of a mail-order business in Houlton, Maine, filed a complaint with the Commission's Consumer Assistance Division (CAD) regarding her Bell Atlantic telephone service. Specifically, she complained that incoming calls on her 800-line were sometimes being dropped after one ring, that she could not obtain a dial tone at times to make outgoing calls, and that customers were not able to reach her over her 800 number during office hours. She also complained that Bell Atlantic staff had been investigating the problem since early summer 1998 and had been unsuccessful in determining and correcting the problem.[10]

In early February, 1999, the CAD became aware of three other businesses in the Houlton area having similar problems with their phone service. All three (a bank, a telemarketing company, and a regional hospital) reported that they were having incoming calls dropped after one ring, having difficulty at times obtaining dial tone to make outgoing calls, and that they periodically received an “all circuits busy” recorded message when making outgoing calls. In addition to these complaints, the CAD had been contacted by the Southern Aroostook Development Corporation about other businesses in the Houlton area that had been experiencing similar problems.

The CAD initiated an informal investigation of these complaints to ascertain the cause of the problems, particularly the problems being experienced by the

[10]In the fall of 1998, the business owner indicated that a Bell technician working on her lines told her that the problem wasn’t in her lines, but was actually in the local switch. She said that the technician said that the problem was congestion in the Houlton switch and until additional equipment was added to the office in Houlton, the problems would continue.

original complainant, the mail order business. Bell Atlantic, as well as AT&T,[11] conducted tests on the lines of mail order business to determine the cause of the problems. This work was in addition to the work already conducted by Bell technicians throughout the summer and fall of 1998.

On February 10, 1999, in a phone conversation with the Assistant Director of the CAD, a Bell engineer indicated that the Company had "figured out" that the cause of the customer's problem was an overloaded switch in the Houlton central office. The engineer went on to say that the Bell staff in charge of managing the Houlton switch had been aware of the problem for "quite some time" and were negotiating with a local ISP to move its lines to the trunk-side of the switch to reduce the traffic through the line-side of the switch. The engineer indicated that Bell staff believed that this measure would alleviate the switch congestion problem. This information raised concerns with the CAD staff because they had been working on this customer's problem with Bell Atlantic since December 16, 1998, and this was the first time that Bell staff mentioned to CAD that Houlton was experiencing switch congestion problems.

On February 12, 1999, the Commission sent a letter to Edward Dinan, President of Bell Atlantic-Maine, asking that Bell:

> 1. Take immediate action to remedy the congestion problem in the Houlton central office switch;
>
> 2. Inform the Commission of congestion problems in any of Bell Atlantic's other central office switches; and
>
> 3. Provide a written description of BA's efforts to ascertain the problem in the Houlton switch and the steps that would be taken to remedy the problem.

B. Bell Atlantic's Responses

[11] AT&T is the customer's intraLATA and interLATA toll carrier.

[Begin Proprietary]

[12]**[Begin Proprietary]**

[End Proprietary]

[13]"Flexpath" is Bell's trade name for a high speed digital service that it provides off the trunk sides of its switches. "ISDN," which stands for Integrated Services Digital Network, is a trunk-side digital service that delivers voice and data signals simultaneously. "ISDN-PRI" (PRI stands for Primary Rate Interface) is a high capacity ISDN service. **[Begin Proprietary]**

[End Proprietary]

[End Proprietary]

[14]We will return to this subject in the next section (Section VII.B.3.) (Note: "SONET," which stands for Synchronous Optical NETwork, is an ultra-high capacity fiber-optic transmission technology.)

[15]**[Begin Proprietary]**

[End Proprietary]

Between February 11, 1999 and April 1, 1999, the Commission became aware of two other businesses in the Houlton area, five customers in the Berwick area, and one customer served by Bell's Old Town switch that were experiencing problems with their telephone service similar to the problems associated with switch congestion.

C. Daily Reports

On March 24, 1999, the Hearing Examiner ordered Bell Atlantic to fax a daily report to the Assistant Director of the Consumer Assistance Division summarizing the status that day of each of eight customers' complaints: three located in Houlton, four in Berwick, and one served by the Old Town switch. The first report described the status of the complaint as of that day. Each subsequent report described actions taken the previous day to address each customer's complaint, the substance of any contact Bell Atlantic had with the customer that day, the results of the contact, and any planned activity. If nothing had changed from an earlier report, that was also noted.

On March 30, the customer from Old Town switch was removed from the report list when his problem was resolved.[16] On April 5, one of the Houlton customers was removed from the list when Bell Atlantic learned that the complainant was not *its* customer, but a customer of a local exchange reseller of Bell Atlantic services. By April

[16]**[Begin Proprietary]**

[End Proprietary]

21, 1999, two of the customers from Berwick had also been removed from the daily report list; one reported that her problem had been resolved, the other asked that Bell Atlantic not call anymore.

On May 13, 1999, the hearing examiner issued a Procedural Order allowing Bell Atlantic to notify the Commission if it believed that the complaints of the remaining four customers had been adequately addressed. Such notice would indicate when the trouble was reported, how it was addressed, whether Bell Atlantic notified the customer that it believed the problem was resolved, and whether the customer concurred. Once all the complaints were resolved, the hearing examiner would issue an Order terminating the daily reporting requirement. The Commission has not received such notification from Bell Atlantic and continues to receive daily status reports on two customers in Houlton and two customers in Berwick.

VII. RESULTS OF INVESTIGATION

A. Lack of Reporting on Network Congestion Between the NOC/NAC and the Customer Service (Repair) Bureaus and Marketing and Sales Operations

[Begin Proprietary]

[End Proprietary] The lack of formal reporting procedures for communicating the existence of network congestion to the key operational units that interact with customers exacerbates the problems congestion causes them. This has two consequences: if a customer reports a congestion-related problem to the repair center and the customer service person taking the call does not know the caller's switch is congested, *and* does not recognize the problem is related to network congestion (and *not* to the customer's equipment, or inside wire, or the lines connecting the customer to the central office switch), that customer service person cannot give the customer correct and accurate service and information.

The other consequence of neither the NOC nor the NAC reporting switch congestion to other operational units is that Bell's marketing and sales agents will continue to fill orders from ISPs for *additional* lines on switches the NOC and NAC may already know to be congested by ISPs' high use lines.

Bell Atlantic has acknowledged that switch congestion is a growing problem in Maine. *See* Dial Tone Speed Order. **[Begin Proprietary]**

[End Proprietary]

B. Problems with Bell's Network Monitoring System

Bell's Network Administration Center is charged with detecting network congestion. Their primary tool is the "exception reports" Bell's computerized network monitoring system (TDMS) generates when network components - such as switch module links, analog and digital line units, umbilical and interoffice trunks - do not perform within established thresholds.

The TDMS generates exception reports every 30 minutes. As a result, in a matter of a few days the TDMS may generate hundreds of exception reports on a single switch, and 5 or 6 NAC personnel must examine hard copy exception reports for each of Bell's 399 switches in Vermont, New Hampshire, Maine, and Rhode Island.

[Begin Proprietary]

[End Proprietary]

According to a NAC Staff Manager, once evidence of possible congestion *is* detected, it can take up to **[Begin Proprietary]** **[End Proprietary]** to confirm congestion exists in one or more network components, and, if line units are congested and load balancing is available as a congestion relief option, to determine which lines are causing it, and which of those lines should be transferred to which other line units. If load balancing does not *fully* relieve the congestion in the switch, customers served by the switch will have to endure the effects of the congestion until Bell either adds line units - a process that can take up to 6 months - or Bell is able to convince any ISPs served off the line side of the switch to move to the trunk side, which (assuming the ISPs agree to it) can also take several months.

If load balancing does not relieve the congestion on a switch, and *only* additional line units will do so, the NAC will recommend the necessary line unit additions to network planners in Bell's Switch Planning and Capacity Management Department. **[Begin Proprietary]**

[End Proprietary]

C. Problems With Bell's Switch Management Practices

1. Bell Has Undersized the Capacity of Some Switches

Switch congestion, when it occurs, is not an all-day event; rather it usually occurs only during peak calling periods. It is the magnitude of the traffic in those busy periods, however, that the switch's call processing capacity must be designed and sized to handle without the switch becoming congested. A switch's "busy season" is the 3 months of the year (not necessarily consecutive) when calling demand is highest; the switch's "high day" is the busiest day in the busy season (excluding holidays, special event days, extreme bad weather days, etc.); the switch's "busy hour" is the busiest hour in the high day. An engineer planning the call handling capacity of a switch would determine its busy hour, and then size the switch's capacity to be able to handle the magnitude of traffic expected during that busiest of hours, and therefore

during all other hours in the year. If the engineer underestimates the busy hour traffic load, then the switch will be congested during the busy hour, and probably in other busy periods during the year.

Bell Atlantic's maximum blocking standard for a local switch's line concentration unit is 4%. Therefore, if the switch has been sized with enough line units to meet peak calling demand, it should block, at most, 4% of calls during the periods of peak calling. **[Begin Proprietary]**

[End Proprietary]

2. Management of ISP Traffic Inadequate

Bell has recently succeeded in convincing ISPs served by the Houlton and Sedgwick switches to change their switch connections from common voice lines to high capacity trunk-side connections. Line unit blocking data Bell has provided on the Sedgwick switch indicates it is no longer congested. Bell has provided data on blocked calls showing that the Houlton switch is also no longer congested, and, the Company claims that the Somersworth, NH switch is blocking 85% fewer calls.

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[17] **[Begin Proprietary]**

[End Proprietary]

The Somersworth switch does not serve any ISPs. Congestion in that switch cannot have been caused by ISPs tying up line units and paths into the switch. **[Begin Proprietary]**

[End Proprietary]

This and other examples of Bell's response to network congestion suggest that, at least on some of its switches, the Company is not *planning* for increases in traffic loads, such as those caused by the growth in Internet traffic, but is *reacting* to actual peak traffic loads that cause switches to become congested or potentially congested. Wherever load balancing does not fully relieve the congestion, customers served by those switches have to endure the effects of congestion until Bell can get the necessary capacity upgrades sized, ordered, delivered, equipped and installed.

Bell's management of the capacity of the Sedgwick switch is instructive. The Sedgwick switch is a small switch that has **[Begin Proprietary]** **[End Proprietary]** analog line concentration units. An ISP served by the switch, in

order to meet the needs of its Internet customers, ordered more and more access lines, until it had about **[Begin Proprietary]**

[End Proprietary]

Had Bell Atlantic been unable to convince the ISP to make the investments necessary to move its service to the trunk side of the Sedgwick switch, it would still be as highly congested as it was before -- and it would have remained congested until Bell Atlantic increased the switch's call handling capacity by installing at least one more line unit, a process that can take up to 6 months. Once Bell determined that switch was congested, had its marketing department or its sales agents been instructed to take no further orders for additional lines from the ISP until the congestion was relieved, that action might have at least kept the congestion on the Sedgwick switch from getting to such extreme levels.

Bell Atlantic realized as early as 1996 that the increasing use of the Internet would have a significant and deleterious impact on its network - unless steps were initiated to address the matter and prevent Internet-based network congestion. Because several of Bell's switches in Maine have become congested and several

[18] **[Begin Proprietary]**

[End Proprietary]

others potentially congested, the steps the Company *has* taken - principally, re-balancing the traffic loads on its switches, adding line units and, recently, convincing ISPs to accept trunk-side serving arrangements - have either been inadequate or have taken much too long to complete.

3. Congestion Relief Should be Given a Higher Priority

We return here to a point discussed above in Section V, namely, Bell's management of the Houlton switch; **[Begin Proprietary]**

[End Proprietary] The immediate relief of *existing congestion* in Bell's network, which can result in blocked calls, delayed dial tone, and no dial tone, should be given a priority equivalent to the priority Bell would give to an emergency.

D. Lack of a Bell Atlantic Corporate-Level Coordinated Responses to Network Congestion

1. Bell Has Not Attempted to Control The Growth of ISP Lines on Congested or Potentially Congested Switches

Bell contends the growth in Internet traffic, and in particular the growth in voice line switch connections of ISPs, is the principal cause of switch congestion. Yet Bell's marketing and sales agents do not routinely identify ISPs *as* ISPs when they order access lines. As a result, even for a switch that may already be congested, an ISP, whose many line-side connections on that switch may be causing the congestion, will be able to order *additional* lines, which of course will exacerbate the congestion.

As indicated earlier, Bell's Network Operation and Administration Centers do not routinely notify the marketing and sales agents that a switch has become congested. If a sales agent *knows* the company ordering lines is an ISP, and even if Network Operations is aware that the ISP's serving switch is congested, Bell states it cannot refuse the ISP's order for additional lines. Bell's tariff, however, which we referred to in Section IV and repeat here, indicates quite the opposite. The tariff states: "The Telephone Company reserves the right to discontinue or refuse service . . . [if] [t]he use of the service [is] in such a manner as to interfere unreasonably with the use of the service by one or more other customers." Thus, in our view, Bell does have both the authority and the *obligation* to limit ISP line-side growth on switches it knows to be congested or potentially congested.

2. Bell Does Not Restrict Its Access Line Promotion Programs to Customers Served by Uncongested Switches

Well after the growing impact of Internet usage on network congestion had taken hold in Maine, Bell has filed tariffs with the Commission that

waive the service and installation charges for additional residential and business lines. These programs provide incentives for residential customers to add a second or third line, and for business customers - including ISPs - to add up to two additional lines. The promotions are unrestricted: residential and business customers, including ISPs, who are served by a switch that may already be congested or potentially congested, can take advantage of the promotions. Thus, Bell Atlantic's promotional tariffs for additional business lines create an incentive for an ISP, whose lines may be causing congestion in a switch, to add more lines at the expense of causing more congestion.

3. Bell Atlantic's Internet Service Can Add to Congestion

Bell Atlantic-Maine's parent corporation, the Bell Atlantic Corporation, includes a unit - Bell Atlantic Internet Service (BAIS) - that operates as an ISP in Maine and nationally. Bell Atlantic-ME has stated that BAIS uses only trunk-side connections to its switches, no line-side connections, which would mean BAIS does not cause any line unit blocking on those switches.

Switch congestion caused by Internet traffic is caused not only by ISPs' line-side switch connections, however, but also by the ISPs' *customers'* line-side connections. To the extent that BAIS has succeeded in attracting *new* Internet users[19] in Bell Atlantic-ME's service territory (rather than attracting existing users from other ISPs), then Bell Atlantic's ISP unit adds to any ISP *customer* -based congestion that occurs in Bell Atlantic-ME's switches.

4. Service Quality Concerns Raised by Mergers and Bell's Centralization of Network Management

[19]Bell's initial marketing of its ISP business included both print and television ads featuring cartoons by Maurice Sendak, a well-known illustrator of childrens' books, declaring "wild things are happening here" [at BAIS].

In Docket No. 96-388, the Commission approved the merger of NYNEX into Bell Atlantic. In the Order granting the approval, the Commission included a discussion of the concerns expressed by the parties to the proceeding regarding the effects that the merger might have on service quality and network reliability. One of the concerns expressed was that because Maine's infrastructure was already in good condition, the merged company might have less incentive to invest in Maine, less competition would result in less incentive to invest in Maine, and the merged entity would possibly invest its capital in other ventures that offered higher potential returns. Another concern was that Bell Atlantic would concentrate its attention on other jurisdictions, because Maine would be a much smaller part of the merged entity.

In order to address these concerns, the Commission required that Bell Atlantic continue its investment in Maine at the same level as it had over the previous four years.[20] In addition, a service outage measure that the Commission had initially ordered in the AFOR docket was to be implemented on an expedited basis. Also, the Commission ordered that its outage reporting rule for telephone utilities, Chapter 20, be revised to include additional outage reporting requirements. Finally, the Commission ordered that Bell Atlantic design a report of benchmarks that would compare facilities, services and prices in Maine with those in the remainder of the Bell Atlantic territory. In sum, the Commission clearly was concerned that service quality and service availability might be negatively affected by the merger, and it included conditions in its merger approval designed to prevent such deterioration.

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[20]This requirement was subsequently rescinded through the Commission's approval of a stipulation in Docket Number 94-123 (Reopened) that dealt with the reduction in access charges required under Maine law.

We cannot conclude from the evidence before us that the switch congestion problems under investigation in the current case are a result, direct or indirect, of the Bell Atlantic/NYNEX merger. Some organizational restructuring done by the merged company, however, may have contributed to Bell's failure to identify network congestion in Maine at an early enough stage to allow for remedial action before the problem reached the critical point that it did for customers. Bell Atlantic has increased the span of control of several managers who have responsibility for planning the network and for identifying and correcting network problems. **[Begin Proprietary]**

[End Proprietary]

We are not criticizing any of these individuals, nor any of the hundreds of Bell employees who plan, manage and maintain Bell's network. It is possible, however, that the Company's more centralized network management structure may have led to an inability to identify and rectify switch congestion problems in a timely manner - much less to prevent congestion from occurring. As discussed

earlier, the Company's primary short-term solution was to rely on load balancing, even as it became evident in certain exchanges that this alone would not be sufficient, and that either additional line units or the movement of ISPs to the trunk sides of their serving switches would be needed. Of course, the Company would have had to reach that conclusion far earlier than it did, given the long lead time involved both for ordering and installing line units and convincing ISPs to change their serving arrangements. We are not able to say whether the cause of the congestion in Bell Maine's network resulted from lessened attention to Maine-specific issues, Bell's highly centralized network management, or a general company policy to delay line unit additions as long as possible, but it is clear that at least in the Houlton, Sedgwick and Somersworth switches, congestion reached an unacceptable level without the merged Bell Atlantic-NYNEX Company having taken adequate action early enough to prevent it.

Now, Bell Atlantic's shareholders have approved a proposed merger with GTE, which the Commission has stated it will likely approve if the Department of Justice and the Federal Communications Commission give their approvals.[21] DOJ has recently given its conditional approval, subject to the divestiture of certain cellular properties. Because Maine would become an even *smaller* part of a consolidated Bell Atlantic-GTE and, because the merged Bell Atlantic-NYNEX company allowed parts of its Maine network to become congested by Internet traffic, the Commission may need to address, either in this proceeding or the pending Bell

[21]Prior to Commission approval, the Commission will consider arguments concerning any concerns specific to Maine raised by proposed intervenors. *See New England Telephone and Telegraph d/b/a Bell Atlantic Maine*, Docket No. 98-808, Order on Reconsideration (Mar. 18, 1999).

Atlantic-GTE merger, Docket No. 98-808, whether we should take more concrete steps to ensure that Maine's infrastructure and service quality needs are not neglected.

VIII. PROPOSED ACTIONS

We offer the suggestions below for Bell Atlantic to consider in addressing the problems identified in this Order. The suggestions focus on improving Bell's internal reporting and communication on network congestion, on improving and speeding up its approaches to detecting and relieving network congestion, and on improving its long-term approaches for preventing avoidable causes of network congestion, such as growth in Internet traffic.

A. To Improve Bell's Internal Communications on Network Congestion

1. When Bell's Network Administration Center determines a switch in Maine is congested or potentially congested, the NAC should report it to the Centralized Service Bureau (repair center) and the Company's marketing operations. With that information (i) repair intake personnel will be able to give accurate information, advice, and service to customers served by the congested switch who call to report congestion-related problems, and (ii Bell's marketing and sales agents will be able to suspend sales of access lines to ISPs served by the switch, and thus contain the congestion.

2. Bell's Centralized Service Bureau should develop a reporting system that collects, statistically summarizes, analyzes, and graphically trends reports of customers' troubles caused by network congestion. The reports should be generated by wire center; reference the *threshold* for no dial tone, delayed dial tone, blocked calls and other congestion-related events; and be sent to Network Operations, the NAC, network planners (the Switch Planning and Capacity Management Department), Marketing and Regulatory departments. The reports' statistical summaries and trended

information could give the groups that manage congestion relief efforts and that plan the capacity of the network an up-to-date, graphic assessment of the actual problems that network congestion is causing Bell's customers in Maine.

B. To Improve Bell's Short-Term Approaches to Detecting and Relieving Network Congestion

1. Network Management

a. Bell should develop a plan to address existing and potential congestion. The plan should:

(1) assign the responsibility and authority for the planning and management of network congestion relief to a *single* group in the Company,

[Begin Proprietary]

[End Proprietary]

(2) specify the particular responsibilities of each Company group in detecting and relieving network congestion and reporting information to the other groups;

(3) designate specific individuals in each group to be responsible for detecting and addressing congestion problems; and

(4) address detecting and relieving network congestion on an immediate, short-term basis, as well as preventing congestion on a long-term basis.

b. Bell Atlantic should manage its switches to its maximum line unit blocking standard of 4%. If the cause of switch congestion is in the switch's line units and load balancing efforts are not expected to fully relieve the congestion, and only additional line units will provide full and immediate relief, Bell must take steps to

have line units readily available to install on the switch. The up-to-6-month lead time for getting additional line units justified, approved, ordered, equipped, furnished, and installed is unacceptable; customers served by a congested switch should not have to wait 6 months to be free of the problems and hazards congestion can cause.

c. If a switch is congested by ISP line-side switch connections, and load balancing will not fully relieve the congestion, and additional line units are not readily available, Bell should invoke its tariff and remove enough ISP lines to relieve the congestion.

d. If a switch is potentially congested by ISP line-side connections, Bell should invoke its tariff and limit or suspend further sales of access lines to any ISP served by the switch.

e. Bell's marketing and sales agents - or some other Company group - should identify ISPs *as* ISPs when they order line-side connections, closely monitor each ISP's line-side growth, and request *additional* projections at least every 6 months.

f. When ISPs are just starting out and begin operations on Bell's network by ordering a small number of voice lines, Bell should have an educational program to explain to the ISPs the benefits (and *necessity*) of their eventually needing to move to trunk-side connections.

g. Bell switches in Maine have become congested because the Company either underestimated actual peak traffic loads that have occurred at the switches or, for whatever reason, the Company failed to adequately time and size the capacities, and capacity upgrades, of those switches and their umbilical trunks. Bell

should make major improvements to how it estimates switch busy hour traffic loads, or to how it times and sizes switch and umbilical capacity and capacity upgrades, or both.

h. **[Begin Proprietary]**

[End Proprietary]

i. Bell should give the relief of network congestion the same priority it gives to relieving conditions caused by an emergency.

2. Network Monitoring

a. Bell needs to drastically reduce the time it takes to detect and fully relieve network congestion. At least for congested and potentially congested switches, Bell should develop the capability to monitor - *graphically*, and *in real time* - the events that most reflect congestion in the network, be it located in analog and digital line concentration units, umbilicals, interoffice trunks, or intra-switch module links.

b. For each performance measurement in Bell's network monitoring system that reflects network congestion - especially measurements of no dial tone, slow dial tone, and blocked calls - the Company should develop a threshold that will trigger *immediate congestion relief*, be it immediate load balancing, or, if that does not fully relieve the congestion, immediate addition of line units, umbilicals, or trunks - whichever network components are causing the congestion.

c. In both its automated network monitoring system and the customer trouble report coding done by Centralized Service Bureau (repair center) intake personnel, Bell should develop the capability to distinguish no dial tone, delayed dial tone, blocked call and other events caused by *network congestion* from the same events caused by downed lines, faulty customer equipment, or other reasons.

d. Bell should develop the capability to detect and measure no dial tone events *as* no dial tone, rather than as *delayed* dial tone events.

e. Bell's High Day Report provides usage and call blocking data for the 15 highest high day - busy hours over the period the report is selected to cover. The report can be run for each line unit (both analog and digital) in a switch module, for umbilicals, for Interoffice trunks, and for links between switch modules. According to Bell, this most informative report on congestion is usually run only once a year, as an input to planning capacity upgrades. For each congested and potentially congested switch, Bell should run the High Day Report every 15 days, until at least a month after the congestion is fully relieved.

3. Tariffs, Service Offerings, and Pricing

Two classes of customers contribute to the load on analog line units and trunks. The first class of users are ISPs or any other customers with line-side switch connections that receive a large number of calls with long holding times during the busy period. The other class is customers with line side connections who originate calls during the busy period with extremely long holding times, who typically are customers calling an ISP. Tariff solutions to reduce network congestion should encourage or require both of these classes of users not to use line side connections for

data traffic. In the long term, Bell should try to move all data users off its analog public switched voice network.

Possible solutions include:[22]

1. Low cost line side offerings (e.g. Centrex lines) should not be made available to either originating or terminating end users generating long hold time data traffic unless those end users demonstrate that most of the use of those lines will be to communicate on the premises of that end user. Centrex lines are priced lower than regular line side business lines so that the Company can compete with Private Branch Exchange (PBX) service providers. Therefore, the low rate should only be applicable to PBX-like solutions. A practice which allows any end user to purchase lower cost Centrex lines provides an economic incentive for an ISP to take a service which is likely to cause switch congestion. ISPs are also less likely to voluntarily subscribe to trunk side connections if line side services available to them are priced very low.

2. Generally, business lines providing line side connections should not be provided to end users with terminating traffic over a certain threshold usage amount during any one-hour period. Users with a large amount of terminating traffic should be limited to one or two line side connections during a transition period. Ultimately they should be required to subscribe to trunk-side connections and digital data services. Originating end users (those calling ISPs) should be encouraged not to leave their line off hook unless they are actually communicating with the ISP. Customers should be informed that leaving their line in use all the time contributes to delaying dial tone and blocking the calls of other users. Bell should develop a plan to deal with those customers who persist in engaging their line all the time.

[22]The suggested solutions would require modifications to Bell's Maine tariffs.

3. Bell Atlantic should price trunk side digital data services in order to make those services economically attractive to ISPs and other large volume users. The ratio between price and cost for trunk side connections and other digital access services likely to be used by ISPs should be no greater than that same ratio for analog line side connections. In addition Bell should consider the avoided cost of not having to make analog line unit additions when pricing digital trunk side services. Bell should also price digital trunk side services on a flat rate basis so they will be attractive when compared to flat rated analog services.

C. To Improve Bell's Long Term Approaches to Prevent Congestion

1. Even if Bell is able to move all ISPs off the line sides of its switches, *Internet users* will still impose long holding time loads on line units and interoffice trunking. Those loads will increase as more and more customers subscribe to ISPs' services. Unless Internet users and other long-holding-time customers migrate to a data network, substantial increases in the voice network's switching and trunking capacity will be necessary. Therefore, Bell should aggressively move all data users off the voice network. That should include making xDSL[23] services available in all areas of Maine on an expedited basis. In addition, Bell Atlantic should make ISDN[24] and frame relay services available everywhere at attractive rates. Where ISDN cannot be provided by a customer's local switch, it should be made available on a Foreign Exchange-like basis without the customer facing additional charges because of that

[23]In "xDSL," DSL stands for Digital Subscribe Line, a technology that enables high speed data transmission over copper cables. There are several DSL technologies, anyone of which the "x" in xDSL can stand for.

[24]"ISDN," which stands for Integrated Services Digital Network, is a trunk-side digital service that delivers voice and data signals simultaneously.

serving arrangement.[25] The availability of xDSL, ISDN, and frame relay services are critical to the objective to remove from the analog voice network the data usage of those customers who originate calls to an ISP (i.e., Internet users). With the numbers of customers having computers and using the Internet growing rapidly, it is imperative to provide these customers with alternatives to reach the Internet. Otherwise, unless Bell Atlantic makes very substantial capacity additions to its voice network in Maine, the network congestion we have seen thus far will be small compared to what we will face in the future.

2. Until Bell's voice network in Maine no longer carriers a significant amount of either originating or terminating Internet traffic, Bell should develop the capability to forecast the impact that the growth in Internet traffic will have on its voice switches and interoffice network, and plan their call handling capacities accordingly.

[25]"Foreign Exchange" service enables a customer to obtain a telephone number in an exchange outside the customer's local (toll-free) calling area (and outside the exchange's local calling area) and receive calls from and make calls to that exchange that are toll-free.

IX. REPORTING REQUIRED[26]

Each month, Bell Atlantic should file the following information:

A. High Day Reports covering each month for all switches that exceed the Company's line unit, switch module link, umbilical trunk, or interoffice trunk congestion thresholds by more than 20%;

B. reports that contain "peg counts" of delayed dial tones, blocked calls, and any other congestion-related events the Company's network monitoring system measures, for all switches that exceed the Company's thresholds for one or more of these events by more than 20%;

C. monthly updates of the ISPs that change from line-side to trunk-side serving arrangements. The report should indicate the switch or switches that serve each ISP and the number of voice-grade lines ISPs still have that are used for Internet traffic; and

D. monthly updates of congested and potentially congested switches. For each switch, the report should indicate which components are congested (line units, umbilicals, trunks), the planned congestion relief methods, and the date the Company expects the congestion to be fully relieved.

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[26] **Advisors' Note: In its response to this Report, Bell should indicate if any of the requested data will be burdensome to prepare, and if it is, propose an alternative report. Bell should also recommend any other Company reports that measure events caused by network congestion. (If any requested or Bell-recommended data is readily available in graphical form, Bell should provide it.)**

X. ORDERING PARAGRAPHS

In this Order we have found problems with Bell Atlantic's network management, monitoring, and congestion relief practices. Accordingly, we order Bell Atlantic to:

1. File a report within 60 days of the date of this Order explaining in detail the steps it will take to ensure that no Bell Atlantic customer in Maine will be unable to obtain a dial tone and complete an emergency telephone call because of avoidable congestion in the Company's network. The report should include the Company's plans:

    a. to minimize occurrences of avoidable congestion in its Maine network;

    b. to improve its internal reporting and communications on network congestion;

    c. to improve its network monitoring and management practices related to detecting network congestion and minimizing its impacts on customers;

    d. to improve and speed up its network congestion relief practices; and

    e. to prevent avoidable congestion from occurring in its Maine network.

2. File the reports required in Section IX of this Order.

Respectfully submitted:

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James Cowie

With Assistance from:

Derek Davidson
Richard Kania
Joel Shifman
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Attachment 1

A Brief Description of Bell Atlantic's Network in Maine

Bell Atlantic's network in Maine consists of a number of large "host" switches, which serve large communities, and a much larger number of smaller "remote" switches, which serve smaller communities. Switches route calls to their destinations, and are located in Bell's "Central Offices." All host switches are connected to each other by high capacity lines called "trunks." Each remote switch is connected to one and only host switch by trunks called "umbilicals." Residential and business customer lines are connected to the "line side" of their local switch, which is either a host or a remote switch. Trunks, umbilicals, and high capacity business lines are connected to the "trunk side" of a switch. (An Internet Service Provider can have both line-side and trunk-side connections to its local switch.)

Bell also has a large "tandem" switch in Maine, to which the host switches are connected, and which also serves as the point at which Bell and other telephone companies access each others' networks. No customer lines are connected to the tandem switch, only trunks from other Bell switches and from other companies' switches.

Figure 1 on the next page is a simplified diagram of Bell's network in Maine.